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Animal and
Plant Health
Inspection
Service

Policy and Program
Development

Environmental and Risk
Analysis Services

Unit 149
4700 River Road
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Document Processing Desk [6(a)(2)]
Office of Pesticide Programs (7504P)
U.S. Environmental Protection Agency
William Jefferson Clinton Building
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460-0001

SUBJECT: **Follow-Up Report: Non-target species exposure to diphacinone in South Carolina from contaminated Kaput Feral Hog Lure; a nontoxic attractant for prebaiting feral swine – Additional analyses and corrections to the original incident description**

The U.S. Department of Agriculture's Animal and Plant Health Inspection Service (USDA APHIS) is submitting a follow up report on an adverse effects incident to comply with the reporting requirements of Section 6(a)(2) of the Federal Insecticide, Fungicide and Rodenticide Act.

Incident Information (Corrections to original submission noted below)

Product name: Kaput Feral Hog Lure; a nontoxic attractant for prebaiting feral swine
Registrant name: ~~USDA APHIS~~ Not applicable (There was no registrant for this product and this product is not a pesticide)
EPA Registration No.: Not applicable
Active ingredient: Diphacinone ~~and Brodifacoum~~ (No brodifacoum was likely involved in this incident as was originally reported)
Bait formulation: Whole corn coated with nontoxic attractant
Product application: In compliance with ~~label~~ manufacturer directions (The product is not a pesticide and does not have a pesticide label)
Incident category: W-B
No. of incidents: 1
Location of incident: US Department of Energy (DOE) Savannah River Site, South Carolina
Incident description (revised):

The University of Georgia (UGA) was conducting a study of Kaput Feral Hog Bait (EPA Reg. No. 72500-26; registered by Scimetrics, LTD. Corp.) in cooperation with the USDA APHIS Wildlife Services (WS) National Wildlife Research Center (NWRC) on the DOE Savannah River Site in South Carolina. During the pre-baiting phase of the field trial, untreated whole corn and a non-toxic, corn-based lure (Kaput Feral Hog Lure manufactured by Scimetrics, LTD. Corp.) were used to acclimate feral swine to bait stations.

The UGA researchers placed the Kaput Feral Hog Lure in 32 of the 58 deployed feeders from July 9, 2019 to July 31, 2019. The other sites were pre-baited with whole corn. Carcasses of seventeen feral swine, seven raccoons, two opossums, one squirrel, and one dove were discovered approximately 9 days after the first night of baiting with Kaput Feral Hog Lure in the vicinity of the bait stations. Suspecting that these deaths were likely from non-natural causes, all Kaput Feral Hog Lure was removed. Samples of the Kaput Feral Hog Lure and samples of carcasses were collected for later testing for the presence of anticoagulant active ingredients. No Kaput Feral Hog Bait containing warfarin was applied during this time period.

A preliminary anticoagulant screen was conducted by the USDA APHIS WS NWRC Chemistry Unit on samples from eight bags of the Kaput Feral Hog Lure used in the study. USDA APHIS reported this incident to EPA on August 14, 2019, because the preliminary screen showed that in addition to bromadiolone, which was the primary anticoagulant detected, the contaminated Kaput Feral Hog Lure contained low levels of diphacinone and brodifacoum. Both diphacinone and brodifacoum are active ingredients in USDA APHIS pesticide products registered with EPA.

Follow-Up Information

A full independent analysis was conducted later by The University of Georgia, College of Veterinary Medicine, Research Services Section. This analysis characterized the active ingredients present in four samples of the contaminated Kaput Feral Hog Lure and carcass tissue samples from two feral swine, one raccoon, and one dove. Bromadiolone was detected in the four contaminated Kaput Feral Hog Lure samples (three samples were above 1 ppm, and one was below 1 ppm) and three mammal carcass samples (570–3,000 ppb). This analysis also detected trace levels of diphacinone and warfarin in all four samples of contaminated Kaput Feral Hog Lure (below 1 ppm) and in the three mammal carcass samples (below 50 ppb). No active ingredients were detected in the liver of the dove carcass; therefore, it likely died from causes other than poisoning from the contaminated Kaput Feral Hog Lure. No brodifacoum was detected in any sample. The complete findings of this independent analysis can be found in the attached report.

If you have any questions regarding this notification, please contact Jim Warren of USDA APHIS Environmental Risk and Analysis Services at (202) 316-3216 or Jim.E.Warren@usda.gov.

Sincerely,

David A. Bergsten

David A. Bergsten
Assistant Chief, Environmental and Risk Analysis Services

cc:
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RESEARCH SERVICES SECTION

FINAL REPORT

SOUTHEASTERN COOPERATIVE WILDLIFE
DISEASE STUDY (SCWDS)
COLLEGE OF VETERINARY MEDICINE
THE UNIVERSITY OF GEORGIA
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CASE NUMBER R19-03, R19-04, R19-05
DATE RECEIVED August 1, 2019
DATE OF REPORT October 4, 2019

STATE SC COUNTY Aiken AREA Aiken

SPECIES (NO.) * SEX * AGE * WEIGHT *

SCWDS ID	*Species	*Sex	*Age	*Weight (kg)
R19-03	Raccoon	Male	Adult	4.46
R19-04	Feral swine	Male	Adult	Unknown
R19-05	Feral swine	Male	Adult	Unknown

CASE HISTORY: The carcasses of two feral swine and a raccoon, the liver of a dove (ID Dove 1), 4 feed samples, and 6 bait samples were submitted by Dr. James Beasley of the University of Georgia (UGA). The three animals were radio-collared as part of a research study that included investigation of feral swine baits. All animals were found dead near a feeder containing a corn-based feed. The animals are believed to have fed on the bait, and all were found dead near the bait. The carcasses were received by SCWDS on August 1, 2019, and were necropsied the same day.

FINAL DIAGNOSIS: R19-03, R19-04, R19-05: Anticoagulant rodenticide toxicosis (bromadiolone toxicity; diphacinone and warfarin exposure)
R19-03: Canine distemper

COMMENTS: Exposure to bromadiolone, a second generation anticoagulant rodenticide, was detected at high concentrations in the liver of all three carcasses. Trace amounts of diphacinone and warfarin were also detected in tissue from all three carcasses, but the levels were too low to be quantified. Although the lethal dose of anticoagulant rodenticides has not been determined for many species, detection of these compounds in conjunction with the gross findings in the present case indicate that these feral swine and raccoon died acutely from uncontrolled bleeding due to poor clotting ability of the blood. The detected anticoagulant rodenticides in the three livers mirror the toxicology test results for the four feed samples, suggesting the submitted feed samples were a likely source of exposure. Warfarin was detected in the six submitted bait samples and the results are considered equivalent among the bait blocks and are close to what is believed to be a target concentration of 50 ppm warfarin. No bromethalin was detected in adipose tissue of R19-03 (raccoon), R19-04 (feral hog), and R19-05 (feral hog), nor any of the four feed samples. No anticoagulant rodenticides were detected in the dove liver. Canine distemper virus was detected in the brain of R19-03; however, this is not suspected to be the cause of death in this raccoon. No rabies virus was detected in the brain of R19-03.

Dr. Beasley was notified of receipt of the carcasses and gross findings on August 1, 2019, and updated on August 2, 6, 13, 22, and 28 (via telephone), and September 5 and 23, 2019, via electronic mail.

WILDLIFE IMPLICATIONS: Many wildlife species can suffer from anticoagulant rodenticide exposure and toxicosis from either direct ingestion of the poison or secondarily by scavenging exposed prey. Anticoagulant rodenticides inhibit the recycling of vitamin K-dependent clotting factors. Affected animals often bleed out due to an inability to adequately form blood clots. Mortality events are not uncommon and can occur as a result of accidental exposure or malicious intent.

Canine distemper is a significant cause of mortality in multiple free-ranging wildlife species, particularly carnivores. It is the most common diagnosis among raccoons and gray foxes submitted to SCWDS. Canine distemper is caused by a morbillivirus that is transmitted by direct contact with the oral, respiratory, or ocular secretions of infected animals.

PUBLIC HEALTH IMPLICATIONS: Anticoagulant rodenticide bait, as well as carcasses of animals that die from ingestion of rodenticides, are considered potentially hazardous to humans. Care should always be taken when handling these chemicals and exposed carcasses. Animals that may have died from ingestion of rodenticides should not be consumed. In such scenarios, recommended precautions include use of personal protective equipment, such as gloves. Consult a public health professional for more information.

Humans are not susceptible to canine distemper, but the disease associated with canine distemper virus infection in free-ranging carnivores can easily be confused with rabies. Dual infections of CDV and rabies have also been reported.

DOMESTIC ANIMAL IMPLICATIONS: Domestic animals can be exposed to anticoagulant rodenticides by accidentally ingesting the poison or scavenging on animals on animals that have previously been exposed. Care should be taken when distributing rodenticides to ensure that domestic animals cannot access these compounds. Consult a local, licensed veterinarian for advice on treatment.

Livestock are not susceptible to canine distemper virus infection. Domestic dogs and ferrets are susceptible to disease due to infection with CDV. Consult a local, licensed veterinarian for more information on available preventative measures.

DIAGNOSTICIAN Melanie Kunkel, DVM, MPH **SUPERVISOR** Nicole Nemeth, DVM, PhD, DACVP

DISTRIBUTION: SCWDS File, Beasley

Laboratory Results Begin on Page 3

GROSS LESIONS:

R19-03: The adult, male raccoon is in good nutritional condition with minimal postmortem autolysis. A moderate amount of blood fills the nasal cavities bilaterally. There is approximately a 4 cm diameter focus of subcutaneous hemorrhage along the left ventral thorax and along the peritoneum of the thoracic cavity. Approximately 100 milliliters of non-clotted blood fills the abdominal cavity. There is a 2.5 cm x 2.5 cm focus of hemorrhage in the left cranial lung lobe, and the right lung lobes are diffusely mottled dark red. There is a 2 cm x 1 cm focus of hemorrhage along the serosal aspect of the distal jejunum, and there is diffuse hemorrhage within the lumen of the small intestines, extending from the proximal aspect of the duodenum to the distal jejunum. A single tapeworm is in the jejunum. The stomach is filled with dark green, mucoid material with flecks of corn, and the small intestines contain a small amount of corn flakes.

R19-04: The adult, male feral pig is in good nutritional condition with minimal postmortem autolysis. There is alopecia circumferentially around the neck (consistent with previous use of a collar), and the cervical vertebrae 1 is dislocated from cervical vertebrae 2 and the spinal cord is severed at this location (suspect postmortem artifact). The skin over the right testicle has an approximately 15 cm laceration extending from the rectum to the distal aspect of the testicle (suspect postmortem artifact). Marked hyperemia is along the ventral abdomen and bilaterally along the axillary and inguinal regions. There is a mild umbilical hernia, and the prepuce is mildly edematous. There is marked subcutaneous hemorrhage along the dorsal cranium. There is no negative pressure on puncture of the diaphragm. Approximately 1 liter of non-clotted blood fills the thoracic cavity, and the pericardial sac is filled with non-clotted blood. The lungs are diffusely mottled dark red, and there is an approximately 5 cm focus of hemorrhage along the cranial portion of the left cranial lung lobe. There is partially clotted blood in the oral cavity, and there is an approximately 10 cm focus of hemorrhage caudal to the left mandible extending from the left ear canal to the left retropharyngeal region. Numerous foci of hemorrhage are scattered within many skeletal muscles throughout the body. There is a 5 cm long focus of skin sloughed along the caudal aspect of the hock bilaterally. Numerous kidney worms (*Stephanurus dentatus)* are bilaterally encysted along the ureters in the perirenal fat and in the kidneys. The stomach, small intestines, and ceca are filled with grain, and the descending colon is filled with formed feces.

R19-05: The adult, male feral pig is in good nutritional condition with minimal postmortem autolysis. There is alopecia circumferentially around the neck (consistent with previous use of a collar), and the cervical vertebrae 1 is dislocated from cervical vertebrae 2 and the spinal cord is severed at this location (suspect postmortem artifact). There is non-clotted blood in the oral cavity, and there is a moderate amount of subdural hemorrhage in the left caudal aspect of the cerebrum. Approximately 0.5 liter of non-clotted blood fills the thoracic cavity, and approximately 1 liter of non-clotted blood fills the abdominal cavity. There is an approximately 5 cm diameter focus of subcutaneous hemorrhage in the distal left cervical region. Numerous foci of hemorrhage are scattered within many skeletal muscles throughout the body, and there are coalescing foci of hemorrhage within the soft tissues of the abdominal body wall, particularly prominent over the caudal ribs and cranial aspect of the abdomen. A 7 cm long focus of hemorrhage is along the serosal aspect of the lesser curvature of the stomach, and there are 3 fractures in the spleen (6 cm long, 2 cm long, and 3 cm long, respectively) that extend into the splenic parenchyma. There is a 3 cm diameter perforation of the cecum, and grainy, yellow to tan digesta diffusely covers the serosal aspect of all abdominal organs. There is a closed, comminuted, metaphyseal and articular fracture of the proximal right tibia, which is surrounded by hemorrhage and associated with non-clotted blood in the stifle joint. There is a mild umbilical hernia. Numerous kidney worms (*Stephanurus dentatus)* are bilaterally encysted along the ureters in the perirenal fat and in the kidneys. There are two lacerations of the lateral aspect of the left hock and a superficial abrasion of the medial aspect of the right hock. The gastrointestinal tract is full of yellow, grainy digesta (consistent with corn-based feed).

MORPHOLOGIC DIAGNOSES:

R19-03:

Gross diagnoses: Hemothorax; multi-organ hemorrhage

R19-04:

Gross diagnoses: Hemothorax; hemopericardium; multi-organ hemorrhage; umbilical hernia; renal *Stephanurus dentatus*

R19-05:

Gross diagnoses: Hemothorax; hemoabdomen; multi-organ hemorrhage; umbilical hernia; right tibial comminuted fracture; renal *Stephanurus dentatus*

TOXICOLOGY:

R19-03, R19-04, R19-05: A sample of liver from each carcass was submitted to the California Animal Health and Food Safety (CAHFS) Laboratories in Davis, CA, for anticoagulant screening. A sample of adipose tissue from each carcass was submitted to CAHFS for bromethalin testing. There is consistent detection of three anticoagulant rodenticides (bromadiolone, diphacinone, and warfarin) in the submitted livers. Bromadiolone was detected at 3000 ppb in R19-03, 570 ppb in R19-04, and 870 ppb in R19-05. Trace levels of diphacinone and warfarin were detected in the liver samples from R19-03, R19-04, and R19-05. These liver results mirror the feed test results (shown below). The toxic metabolite of bromethalin, desmethylbromethalin, was not detected in any of the adipose tissue samples.

R19-03:

Anticoagulants Screen

Analyte	Result in parts per billion (PPB)	Reporting limit (PPB)
Brodifacoum	Not detected	20
Bromadiolone	**3000**	**50**
Chlorophacinone	Not detected	20
Coumachlor	Not detected	20
Difethialone	Not detected	20
Diphacinone	**Trace**	**50**
Warfarin	**Trace**	**50**
Difenacoum	Not detected	20

Bromethalin Screen

Analyte	Result in parts per billion (PPB)	Reporting limit (PPB)
Desmethylbromethalin	Not detected	1.0

R19-04:

Anticoagulants Screen

Analyte	Result in parts per billion (PPB)	Reporting limit (PPB)
Brodifacoum	Not detected	20
Bromadiolone	**570**	**50**
Chlorophacinone	Not detected	20
Coumachlor	Not detected	20
Difethialone	Not detected	20
Diphacinone	**Trace**	**50**
Warfarin	**Trace**	**50**
Difenacoum	Not detected	20

Bromethalin Screen

Analyte	Result in parts per billion (PPB)	Reporting limit (PPB)
Desmethylbromethalin	Not detected	1.0

R19-05:

Anticoagulants Screen

Analyte	Result in parts per billion (PPB)	Reporting limit (PPB)
Brodifacoum	Not detected	20
Bromadiolone	**870**	**50**
Chlorophacinone	Not detected	20
Coumachlor	Not detected	20
Difethialone	Not detected	20
Diphacinone	**Trace**	**50**
Warfarin	**Trace**	**50**
Difenacoum	Not detected	20

Bromethalin Screen

Analyte	Result in parts per billion (PPB)	Reporting limit (PPB)
Desmethylbromethalin	Not detected	1.0

Feed samples: Samples of feed were submitted to the CAHFS Laboratory for testing for anticoagulant rodenticides and bromethalin. The CAHFS toxicologist, Dr. Poppenga reports that the submitted feed samples are the likely source of exposure for R19-03, R19-04, and R19-05. The toxic metabolite of bromethalin, desmethylbromethalin, was not detected in the tested samples at or above the indicated reporting limit.

24-3 Feed:

Anticoagulants Screen

Analyte	Result in parts per million (PPM)	Reporting limit (PPM)
Brodifacoum	Not detected	1.0
Bromadiolone	**Positive**	**1.0**
Chlorophacinone	Not detected	1.0
Coumachlor	Not detected	1.0
Difethialone	Not detected	1.0
Diphacinone	**Trace**	**1.0**
Warfarin	**Trace**	**1.0**
Difenacoum	Not detected	1.0

Bromethalin Screen

Analyte	Result in parts per billion (PPB)	Reporting limit (PPB)
Desmethylbromethalin	Not detected	100

24-8 Feed:

Anticoagulants Screen

Analyte	Result in parts per million (PPM)	Reporting limit (PPM)
Brodifacoum	Not detected	1.0
Bromadiolone	**Positive**	**1.0**
Chlorophacinone	Not detected	1.0
Coumachlor	Not detected	1.0
Difethialone	Not detected	1.0
Diphacinone	**Trace**	**1.0**
Warfarin	**Trace**	**1.0**
Difenacoum	Not detected	1.0

Bromethalin Screen

Analyte	Result in parts per billion (PPB)	Reporting limit (PPB)
Desmethylbromethalin	Not detected	100

S7 Feed:

Anticoagulants Screen

Analyte	Result in parts per million (PPM)	Reporting limit (PPM)
Brodifacoum	Not detected	1.0
Bromadiolone	**Trace**	**1.0**
Chlorophacinone	Not detected	1.0
Coumachlor	Not detected	1.0
Difethialone	Not detected	1.0
Diphacinone	**Trace**	**1.0**
Warfarin	**Trace**	**1.0**
Difenacoum	Not detected	1.0

Bromethalin Screen

Analyte	Result in parts per billion (PPB)	Reporting limit (PPB)
Desmethylbromethalin	Not detected	100

S4 Feed:

Anticoagulants Screen

Analyte	Result in parts per million (PPM)	Reporting limit (PPM)
Brodifacoum	Not detected	1.0
Bromadiolone	**Positive**	**1.0**
Chlorophacinone	Not detected	1.0
Coumachlor	Not detected	1.0
Difethialone	Not detected	1.0
Diphacinone	**Trace**	**1.0**
Warfarin	**Trace**	**1.0**
Difenacoum	Not detected	1.0

Bromethalin Screen

Analyte	Result in parts per billion (PPB)	Reporting limit (PPB)
Desmethylbromethalin	Not detected	100

Bait samples: Samples of bait were submitted to the CAHFS Laboratory for testing for anticoagulant rodenticides. Note the results from the testing of the bait blocks. The CAHFS toxicologist, Dr. Poppenga, reported "While there are some slight concentration variations, normal analytical variation is likely the cause. The results should be considered equivalent among the blocks and are close to what we believe to be a target concentration of 50 ppm warfarin."

Batch 1A Bait:

Anticoagulants Screen

Analyte	Result in parts per million (PPM)	Reporting limit (PPM)
Brodifacoum	Not detected	5.0
Bromadiolone	Not detected	5.0
Chlorophacinone	Not detected	5.0
Coumachlor	Not detected	5.0
Difethialone	Not detected	5.0
Diphacinone	Not detected	5.0

Warfarin	**73**	**5.0**
Difenacoum	Not detected	5.0

Batch 1B Bait:

Anticoagulants Screen

Analyte	Result in parts per million (PPM)	Reporting limit (PPM)
Brodifacoum	Not detected	5.0
Bromadiolone	Not detected	5.0
Chlorophacinone	Not detected	5.0
Coumachlor	Not detected	5.0
Difethialone	Not detected	5.0
Diphacinone	Not detected	5.0
Warfarin	**68**	**5.0**
Difenacoum	Not detected	5.0

Batch 1C Bait:

Anticoagulants Screen

Analyte	Result in parts per million (PPM)	Reporting limit (PPM)
Brodifacoum	Not detected	5.0
Bromadiolone	Not detected	5.0
Chlorophacinone	Not detected	5.0
Coumachlor	Not detected	5.0
Difethialone	Not detected	5.0
Diphacinone	Not detected	5.0
Warfarin	**67**	**5.0**
Difenacoum	Not detected	5.0

Batch 2A Bait:

Anticoagulants Screen

Analyte	Result in parts per million (PPM)	Reporting limit (PPM)
Brodifacoum	Not detected	5.0
Bromadiolone	Not detected	5.0
Chlorophacinone	Not detected	5.0
Coumachlor	Not detected	5.0
Difethialone	Not detected	5.0
Diphacinone	Not detected	5.0
Warfarin	**61**	**5.0**
Difenacoum	Not detected	5.0

Batch 2B Bait:

Anticoagulants Screen

Analyte	Result in parts per million (PPM)	Reporting limit (PPM)
Brodifacoum	Not detected	5.0
Bromadiolone	Not detected	5.0
Chlorophacinone	Not detected	5.0
Coumachlor	Not detected	5.0
Difethialone	Not detected	5.0
Diphacinone	Not detected	5.0
Warfarin	**56**	**5.0**
Difenacoum	Not detected	5.0

Batch 2C Bait:

Anticoagulants Screen

Analyte	Result in parts per million (PPM)	Reporting limit (PPM)
Brodifacoum	Not detected	5.0
Bromadiolone	Not detected	5.0
Chlorophacinone	Not detected	5.0
Coumachlor	Not detected	5.0
Difethialone	Not detected	5.0
Diphacinone	Not detected	5.0
Warfarin	**62**	**5.0**
Difenacoum	Not detected	5.0

Dove 1: A sample of liver from a dove was submitted to CAHFS for anticoagulant rodenticide testing. This liver sample contained none of the listed anticoagulant rodenticides in a concentration greater than the stated reporting limits.

Anticoagulants Screen

Analyte	Result in parts per billion (PPB)	Reporting limit (PPB)
Brodifacoum	Not detected	20
Bromadiolone	Not detected	20
Chlorophacinone	Not detected	20
Coumachlor	Not detected	20
Difethialone	Not detected	20
Diphacinone	Not detected	20
Warfarin	Not detected	20
Difenacoum	Not detected	20